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IS 3671-1 (1980): Air Dielectric Variable Tuning Capacitors, Part I: Tests and General Requirements [LITD 5: Semiconductor and Other Electronic Components and Devices]



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“Knowledge is such a treasure which cannot be stolen”

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IS : 3671 (Part I) - 1980

Indian Standard
SPECIFICATION FOR
AIR DIELECTRIC VARIABLE
TUNING CAPACITORS

PART I TESTS AND GENERAL REQUIREMENTS

(First Revision)

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Indian Standard

SPECIFICATION FOR AIR DIELECTRIC VARIABLE TUNING CAPACITORS

PART I TESTS AND GENERAL REQUIREMENTS

(First Revision)

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Indian Standard
SPECIFICATION FOR
AIR DIELECTRIC VARIABLE
TUNING CAPACITORS

PART I TESTS AND GENERAL REQUIREMENTS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 11 August 1980, after the draft finalized by the Capacitors Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard requires reference to IS : 7748 (Part I)-1975* in which details of various tests prescribed, have been fully covered. Only the appropriate degrees of severity and any other special conditions relating to certain tests have been included in this standard.

0.3 This standard was originally published in December 1966 and was largely based on IEC Doc : 40 (Secretariat) 140 ' Draft standard for variable capacitors air dielectric '. Subsequently IS : 7748 (Part I)-1975* was brought out which gives methods of tests for all types of variable capacitors. This standard is being revised with a view:

- a) to bringing it in line with IS : 7748 (Part I)-1975* and also with the latest IEC standards on the subject;
- b) to reviewing the schedule of type tests and number of samples required;
- c) to reviewing the schedule of acceptance tests, AQL values and inspection level required; and
- d) to improving certain performance requirements.

*Specification for variable capacitors: Part I Tests and general requirements.

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0.4 This standard is largely based on IEC Pub 418-2 (1976) 'Variable capacitors: Part 2: Type specification for variable capacitors Type A', issued by International Electrotechnical Commission.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated^{*} expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) covers requirements for judging the mechanical, electrical and environmental properties of air dielectric variable capacitors, intended for use in electronic and telecommunication equipment.

1.2 The general requirements and tests described in this standard are applicable to each section of multi-section capacitors, unless otherwise specified in the detail specification.

1.3 This standard may also be applied to tuning capacitors fitted with trimmers.

1.4 Trimmers and capacitors of the preset and differential types are not covered by this standard.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 7748 (Part I)-1975† shall apply.

3. DESCRIPTIVE CODE

3.1 The description of the type (function), dielectric, style and application (grade) of these types of capacitors shall be in accordance with **3.1** of IS : 7748 (Part I)-1975†.

*Rules for rounding off numerical values (*revised*).

†Specification for variable capacitors: Part I Tests and general requirements.

4. CLIMATIC CATEGORIES

4.1 The preferred climatic categories are:

Climatic Test [Ref IS : 9000 (Part I)-1977*]	Severities			
	Category 1/		Category 2	Category 3
	Category 1A	Category 1B		
	(1)	(2)	(3)	(4)
Dry heat	100°C	85°C	85°C	70°C
Cold	−55°C	−55°C	−40°C	−10°C
Damp heat (long term)	56 days	56 days	21 days	4 days
Damp heat (accelerated)	6 cycles	6 cycles	2 cycles	1 cycle
Rapid change of temperature	+100°C to −55°C	+85°C to −55°C	+85°C to −40°C	—
Low air pressure	4.4 kPa	15 kPa	30 kPa	—

5. CONSTRUCTION AND WORKMANSHIP

5.1 Provisions of 5 of IS : 7748 (Part I)-1975† shall apply with the following details:

- Unless otherwise specified, the capacitors shall be provided with tag type terminals.
- Multisection capacitors for use in superhetrodyne receivers should normally have the RF section near the receiving end and oscillator section at the opposite end, unless agreed otherwise.

6. RATINGS

6.1 **Nominal Capacitance** — This value shall be specified in the relevant detail specification and shall comprise of the following:

- capacitance swing (nominal), and
- minimum capacitance (nominal).

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Specification for variable capacitors: Part I Tests and general requirements.

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6.2 Rated Voltage — The rated voltage shall be selected from the R5 series (*see* IS : 1076-1967*) and where intermediate values are required, these shall be chosen from the R10 series.

6.3 Capacitance Law — This shall be specified in the relevant detail specification.

7. MARKING

7.1 The following marking information in the order given below is required:

- a) Minimum capacitance and capacitance swing;
- b) Rated voltage;
- c) Manufacturer's name or trade-mark; and
- d) Week (or month) and year of manufacture, this may be in coded form as given in IS : 8186-1976†.

7.1.1 The capacitors shall be clearly marked with items (a) and (b) of 7.1 and with as many as possible of the remaining items as are considered useful.

7.1.2 The package containing the capacitor(s) shall be clearly marked with all the information listed above.

7.1.3 Any other marking as agreed upon between the manufacturer and the purchaser.

7.2 The capacitors may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8. GENERAL CONDITIONS FOR TESTS

8.1 General conditions for tests shall be as specified in 8 of IS : 7748-1975‡ with the following details:

- a) Wherever required the capacitors shall be mounted by using method A of 8.6 of IS : 7748-1975‡, unless otherwise specified.

*Preferred numbers.

†Marking codes for values and tolerances of resistors and capacitors.

‡Specification for variable capacitors: Part I Tests and general requirements.

- b) For tuning capacitors fitted with trimmers, the trimmers shall be set to minimum capacitance position for all tests.

9. CLASSIFICATION OF TESTS

9.1 Type Tests

9.1.1 Number of Samples and Sequence of Type Tests — The number of samples for type tests shall be 35 or 30 in each type depending upon whether electrical endurance test is to be carried out or not. The sequence of type tests shall be as given in Table 1.

NOTE — Capacitors which have been subjected to type tests shall not be used in equipment or returned to bulk supply.

TABLE 1 SCHEDULE OF TYPE TESTS

GROUP	TEST	NUMBER OF SAMPLES
0	Visual examination	35 or 30 depending upon whether electrical endurance test is to be carried out or not
	Dimensions and effective angle of rotation	
	Capacitance	
	Tangent of loss angle	
	Voltage proof	
	Insulation resistance	
	Operating torque	
	Rotor contact resistance	
	Sealing (normal condition- ing) (where applicable)	
	Backlash	
1	Locking (if applicable)	10
	Locking proof torque (if applicable)	
	End stop torque	
	Thrust and pull (axial)	
	Side thrust	
	Robustness of terminations	
	Solderability	
	Vibration	
	Bump	
	Shock	
2	Acceleration (steady state)	5
	Rapid change of temperature	
3	Climatic sequence	5
	Damp heat (long term)	
4	Endurance :	5 (wherever required)
	i) Mechanical endurance	
5	ii) Electrical endurance	5
	Resistance to soldering heat	
5	Mould growth	5
	Temperature coefficient	
	Capacitance drift	
	Salt mist	

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9.1.2 Criteria for Approval — There shall be no single failure in any of the type tests.

9.2 Routine Tests — The following tests shall be carried out on each and every capacitor:

- a) Visual examination,
- b) Voltage proof (as a flash test),
- c) Capacitance, and
- d) Sealing (in the case of sealed types).

9.3 Acceptance Tests — From the lot which has passed routine tests, two groups of samples (Group A and Group B) shall be selected and the capacitor shall be subjected to the tests in the order given in Table 2.

TABLE 2 SCHEDULE OF ACCEPTANCE TESTS

TEST	CLAUSe REF IN IS : 7748 (PART I)-1975*	AQL (DEFECTIVES)	INSPECTION LEVEL	D/ND
(1)	(2)	(3)	(4)	(5)
<i>Group 'A'</i>		1 percent	II	
Dimensions	10.2			
Tangent of loss angle	11.3			
Operating torque	12.3			ND
Insulation resistance	11.5			
Rotor contact resistance	11.6			
<i>Group 'B'</i>				
<i>Sub-group B1</i>		4 percent	S ₃	ND
Thrust and pull (axial)	12.7			
Side thrust	12.8			
<i>Sub-group B2</i>		4 percent	S ₃	D
Solderability	12.11			
Robustness of terminations	12.9			
Bump	12.12			
Climatic	13.0			
<i>Sub-group B3</i>		4 percent	S ₃	ND
Temperature coefficient	11.7			

ND = Non-destructive, D = Destructive

*Specification for variable capacitors: Part I Tests and general requirements.

10. GENERAL TESTS

10.1 Provisions of **8** of IS : 7748 (Part I)-1975* shall apply.

11. ELECTRICAL TESTS

11.1 Capacitance — The provisions of **11** of IS : 7748 (Part I)-1975* shall apply with the following detail:

- a) The capacitance shall be measured at a frequency of $1 \text{ MHz} \pm 10$ percent or $1 \text{ kHz} \pm 10$ percent or at any other frequency specified in the detail specification;
- b) The maximum capacitances and the capacitance law shall be measured at the measuring angles specified in the detail specification; and
- c) Where coupling capacitance is applicable, the limits of coupling and the sections between which it is to be measured; shall be specified in the detail specification.

11.2 Tangent of Loss Angle — Provisions of **11.3** of IS : 7748 (Part I)-1975* shall apply with the following details:

Measurements conditions and $\tan \delta$ values shall be as follows:

<i>Capacitance</i>	<i>Frequency</i>	<i>Tan δ</i>
pF	MHz	
Maximum and Minimum capacitance	$1 \text{ MHz} \pm 10$ percent	6.6×10^{-4} for category 1 20×10^{-4} for categories 2 and 3

11.3 Voltage Proof — Provisions of **11.4** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) **Test voltage** — 2 times the rated voltage, and
- b) **Point of application of test voltage** — between rotor and stator of each section.

11.3.1 If break-down occurs, the capacitors shall not be used for further tests.

11.3.2 In rotating the rotor while the test voltage is applied, care should be taken to avoid making contact between an insulated tic-bar and the stator.

*Specification for variable capacitors: Part I Tests and general requirements.

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11.4 Insulation Resistance — The provisions of **11.5** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) Points of application of the voltage — between each pair of electrodes, that is, stator to rotor, stator to case, rotor to case and from rotor to rotor when insulated,
- b) Position of rotor — minimum capacitance position, and
- c) Minimum permitted value of insulation resistance — 1 00 000 M Ω .

11.5 Rotor Contact Resistance — Provisions of **11.6** of IS : 7748 (Part I)-1975* shall apply. Value of rotor contact resistance shall not exceed 10 m Ω .

11.6 Temperature Coefficient — Provisions of **11.7** of IS : 7748 (Part I)-1975* shall apply.

11.7 Capacitance Drift — Provisions of **11.8** of IS : 7748 (Part I)-1975* shall apply.

12. MECHANICAL TESTS

12.1 Visual Examination — Provisions of **12.1** of IS : 7748 (Part I)-1975* shall apply.

12.2 Dimensions and Angle of Effective Rotation — Provisions of **12.2** of IS : 7748 (Part I)-1975* shall apply.

12.3 Operating Torque — Provisions of **12.3** of IS : 7748 (Part I)-1975* shall apply.

12.4 Locking (for Capacitors Fitted with Integral Locking Device) — Provisions of **12.4** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) Locking torque — as specified in detail specification,
- b) Maximum permitted capacitance change after locking — 1.0 percent or 0.2 pF whichever is greater,
- c) Torque applied to the locked actuating device — as specified in the relevant detail specification, and
- d) Maximum permitted change in capacitance value after application of torque — 0.2 percent or 0.2 pF whichever is greater.

12.5 Locking Proof Torque (for Capacitors Fitted with Integral Locking Device) — The provisions of **12.5** of IS : 7748 (Part I)-1975* shall apply.

*Specification for variable capacitors: Part I Tests and general requirements.

12.6 End Stop Torque (for Capacitors Fitted with End Stop) — Provisions of **12.6** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) Applied torque — 0.5 Nm, and
- b) If a rotor tie-bar is to be tested as an end stop or if a capacitor with a reduction gear greater than 1.5 is to be tested the applied torque shall be 0.25 Nm.

12.7 Thrust and Pull (Axial) — Provisions of **12.7** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) Thrust for capacitance charge — 10 N
- b) Maximum permissible thrust — 30 N
- c) Maximum permissible pull — 30 N
- d) Maximum permitted capacitances — 1 percent or 0.2 pF whichever is greater.

12.8 Side Thrust — Provisions of **12.8** of IS : 7748 (Part I)-1975* shall apply with the following details:

Applied thrust — 10 N.

12.9 Robustness of Terminations — Provisions of **12.9** of IS : 7748 (Part I)-1975* shall apply with the following details:

Pull for tensile test — 5 N.

12.10 Soldering — The provisions of **12.11** of IS : 7748 (Part I)-1975* shall apply.

12.11 Bump — Provision of **12.12** of IS : 7748 (Part I)-1975* shall apply with the following additional details:

- a) *Method of mounting* — Method B of **5.6** of IS : 7748 (Part I)-1975*, and
- b) *Severity* — as specified in the relevant detail specification.

12.12 Vibration — Provisions of **12.14** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) *Method of mounting* — method B of **5.6** of IS : 7748 (Part I)-1975*, and
- b) *Severity* — i) 10-2 000 Hz, 15 g, 3 × 3 hours for category 1.
ii) 10-55 Hz, 2 × 3 hours for categories 2 and 3.

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12.13 Shock — Provisions of **12.13** of IS : 7748 (Part I)-1975* shall apply with the following additional details:

- a) *Method of mounting* — Method B of **5.6** of IS : 7748 (Part I)-1975*
- b) *Severity* — as specified in the relevant detail specification.

12.14 Acceleration — Provisions of **12.15** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) *Method of mounting* — Method B of **5.6** of IS : 7748 (Part I)-1975*, and
- b) *Severity* — as specified in the relevant detail specification.

12.15 Sealing (Normal Conditioning) (Where Applicable) — Provisions of **12.16** of IS : 7748 (Part I)-1975* shall apply.

13. CLIMATIC TESTS

13.1 Climatic Sequence — Provisions of **13.1** of IS : 7748 (Part I)-1975* shall apply.

13.1.1 Initial Measurements — The capacitance shall be measured.

13.1.2 Dry Heat — Provisions of **13.1.2** of IS : 7748 (Part I)-1975* shall apply.

13.1.3 Damp Heat (Accelerated) First Cycle — Provisions of **13.1.3** of IS : 7748 (Part I)-1975* shall apply.

13.1.4 Cold — Provisions of **13.1.4** of IS : 7748 (Part I)-1975* shall apply.

13.1.5 Low Air Pressure — Provision of **13.1.5** of IS : 7748 (Part I)-1975* shall apply.

13.1.6 Damp Heat (Accelerated) Remaining Cycles — Provisions of **13.1.6** of IS : 7748 (Part I)-1975* shall apply.

13.1.7 Final Measurements — After recovery, the capacitors shall be subjected to the tests as specified in **13.1.6.2** of IS : 7748 (Part I)-1975* with the following additional details:

The rotor shall be set and maintained throughout the test in a position at near maximum capacitance.

13.2 Damp Heat (Long Term Exposure) — Provisions of **13.2** of IS : 7748 (Part I)-1975* shall apply with the following details:

The rotor shall be set and maintained throughout test in a position at near maximum capacitance.

*Specification for variable capacitors: Part I Tests and general requirements.

14. SALT MIST

14.1 The provisions of **14** of IS : 7748 (Part I)-1975* shall apply.

15. MOULD GROWTH

15.1 The provisions of **15** of IS : 7748 (Part I)-1975* shall apply.

16. ENDURANCE

16.1 Mechanical Endurance — Provisions of **16.1** of IS : 7748 (Part I)-1975* shall apply with the following details:

- a) Capacitors fitted with locking devices shall be locked and unlocked the number of times specified in the detail specification,
- b) Rate of operation of rotor shaft — 10 to 15 cycles per minute
- c) Number of cycles — 10 000 for category 1 and
5 000 for categories 2 and 3.
- d) Final measurements — operating torque shall not be less than 50 percent of the minimum value and not more than 150 percent of the minimum value, specified in **12.3**.

16.2 Electrical Endurance (Where Applicable) — Provisions of **16.2** of IS : 7748 (Part I)-1975* shall apply with the following details:

The capacitor shall be subjected to the upper category temperature for 1 000 hours with the test voltage continuously applied.

*Specification for variable capacitors: Part I Tests and general requirements.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	$1 \text{ N} = 1 \text{ kg.m/s}^2$
Energy	joule	J	$1 \text{ J} = 1 \text{ N.m}$
Power	watt	W	$1 \text{ W} = 1 \text{ J/s}$
Flux	weber	Wb	$1 \text{ Wb} = 1 \text{ V.s}$
Flux density	tesla	T	$1 \text{ T} = 1 \text{ Wb/m}^2$
Frequency	hertz	Hz	$1 \text{ Hz} = 1 \text{ c/s (s}^{-1}\text{)}$
Electric conductance	siemens	S	$1 \text{ S} = 1 \text{ A/V}$
Electromotive force	volt	V	$1 \text{ V} = 1 \text{ W/A}$
Pressure, stress	pascal	Pa	$1 \text{ Pa} = 1 \text{ N/m}^2$

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